



# Naval Medical Research and Development

## Enterprise Laboratories

[Home](#)[Enterprise](#)[Laboratories](#)[Collaboration](#)[News & Media](#)[Research](#)[Resources](#)

## News Releases

### Content Editor

---

#### Lightening the Load: The Science Behind Finding the Balance Between Combat Load, Survivability, Health, and Performance

Released: 11/17/2016

From Naval Health Research Center Public Affairs

---



*A U.S. Marine with Hotel Company, Marine Combat Training (MCT) Battalion, School of Infantry-East, holds his pack while conducting a 15 kilometer conditioning hike on Marine Corps Air Station New River, May 19, 2015. The 15k hike is the last conditioning hike entry-level Marines complete at the culmination of their 29-day training cycle. (U.S. Marine Corps photo by SOI-East Combat Camera Cpl. Andrew Kupperts/Released160519-M-NT768-002 )*

---

SAN DEIGO - How fast can you run 50 yards? Now, add an 80 pound backpack and how fast can you run that same distance? Probably not quite as fast.

If you're a warfighter, running across open ground in battle, adding just one second to your time could be the difference between life and death.

Aside from matters of life and death, the long-term impact of carrying heavy loads may cause wear and tear on bones and muscles, potentially leading to acute and chronic injuries. Finding ways to lighten the load that modern warfighters carry is important to survivability and injury prevention. But doing it right and making sure service members have all the protection and gear they need for their mission while also being able to perform operational tasks is crucial. That's where science and research come in.

### News Releases

NAMRU-3 Researchers Contributed to the Influenza Vaccination Selection for 2016

R & D Chronicles - The Mosquito Fighters, Part VIII: Malaria Control in the Pacific War

Deputy Assistant Secretary of Defense for Research Visits NHRC

Lightening the Load: The Science Behind Finding the Balance Between Combat Load, Survivability, Health, and Performance

NAMRU-3 Change of Command Ceremony Highlights the Importance of Collaboration

Rear Adm. Chinn, Defense Health Agency's Director of Research Development and Acquisition Visits NAMRU-Dayton

NAMRU-SA Announces the Publication of Research on Novel Nanofibrous Scaffolds for Next Generation Antimicrobial Wound Dressing

U.S. Army and Navy Forces Collaborate with African Partners in the Fight against Malaria

NMRC and WRAIR Team Up to Launch Joint West Africa Research Group in Nigeria

R&D Chronicles: The Mosquito Fighters, Part VII - The Inimitable Dr. Stitt and the Navy Medical School

NAMRU San Antonio Participates in First Local Bioscience Research Database Website

Navy Surgeon General Conducts All Hands Call with Navy Research Unit in Cairo

Combat Artist Documents Navy Medicine Research and Development Activities at NAMRU-SA

NSMRL Hosts Young Scientists as Part of STEM Programs

For the past several years, Karen Kelly, Ph.D., a research physiologist at the Naval Health Research Center (NHRC), has studied the effects of load carriage on mobility, performance, and injury trends in U.S. Marines. Her research assesses the relationship between the weight of the loads carried by service members, potential injury, and operational performance.

“Modern warfare requires that warfighters carry large, physical loads into the operational environment to accomplish their mission,” said Kelly. “Body armor has become a necessity in military operations. Unfortunately, it usually consists of several heavy protective plates. And, in addition to body armor, military personnel typically carry essential gear, food, and water, all of which add to the load. Based on self-report surveys, infantry Marines carry, on average, over 85 pounds of mission essential equipment in their combat loads.”

Kelly’s recent studies investigated how different load carriage weights affect the spine and a warfighter’s ability to perform specific operational tasks. Additional research focused on testing and evaluating personal protective equipment (PPE) prototypes to assess their impact on gait, balance, marksmanship, potential for musculoskeletal injury, and subjective feedback such as comfort and perceived exertion.

“Finding the right balance between weight, function, and protection is a challenge,” said Kelly. “Conducting comprehensive testing and evaluation on new equipment and studying how different aspects of load carriage impact warfighter physiology is crucial to minimizing injuries and optimizing performance.”

From the field to the lab, Kelly and her team are doing the research to provide a scientific basis for helping find that balance.

One of Kelly’s first studies to address the issue of load carriage in terms of injury potential and performance was conducted with Marines who were relatively new to the military, having served for less than a year. The study was designed to determine how heavy loads affected the compression of intervertebral discs, movement of the spine, and the ability to perform operational tasks.

Kelly and her team, in collaboration with staff from the orthopedics department at the University of California San Diego, analyzed the spines of the Marines who participated in the study using magnetic resonance imaging (MRI) while they wore varying weights and assumed different positions, just as they would in the field (sitting, standing, and prone on their elbows). Kelly found that loads greater than 30 percent of an individual’s body weight decreased both performance and marksmanship.

Kelly and her team evaluated the physiological and biomechanical effects of prototype equipment in both a controlled laboratory setting and a field environment to assess the new gear and compare it to legacy equipment. NHRC’s strategic location in San Diego and unique research capabilities makes it the ideal lab for conducting this type of research. Among the many land, air, sea, and special operations units in the region, Marine Corps Base Camp Pendleton is just over an hour from NHRC, providing researchers with access to numerous infantry units.

“Evaluating prototype equipment while warfighters wear the gear and perform operational tasks in both a controlled lab environment and out in the field allows us to better assess that gear’s impact on performance and potential for injury,” said Kelly.

[Navy Medicine’s Deputy Chief Readiness, Health, Visits NHRC](#)

[Bacteriophage-based Therapy Overcame an A. baumannii Infection](#)

[NMRC’s Lt. Watters Competes in NATO Chess Tournament](#)

[NAMRU-SA Research Responds to the Specific Needs of Warfighters and Clinicians in Posters Sessions at MHSRS 2016](#)

[NMRC Commanding Officer Tours Bone Marrow Research Lab](#)

[Navy Medicine Patent Attorneys Provide Researchers Patent Process Seminar at NMRC](#)

To do this, Kelly collaborated with fellow NHRC scientist and biomedical engineer, Pinata Sessoms, Ph.D, to leverage the research capabilities of the Computer Assisted Rehabilitation Environment (CAREN), an immersive virtual reality system in NHRC’s Warfighter Performance Lab. Sessoms and her team used the CAREN to measure reaction time, head and eye movement, balance behavior, and muscle activation in relation to the prototype gear.

In the field, Kelly and her team analyzed muscle activation, walking speed, spine kinematics (the movement of the spine), range of motion, and cognitive function as well as more subjective data such as how the Marines wearing the gear perceived levels of comfort and exertion during operational tasks.

Researchers then analyzed the data gathered from the lab and field to develop a comprehensive comparison of the prototype equipment against existing PPE.

“The work we do, the whole point of our research, is to improve the operational readiness of our warfighters,” said Kelly. “By using scientific methods to assess how mission essential equipment impacts the musculoskeletal system, optimal performance, and survivability, we are putting vital and validated knowledge into the hands of decision-makers to help them optimize the balance between carriage load and survivability, health, and performance.”

**Enterprise**

[About US](#)  
[Leadership](#)  
[FAQs](#)

**Laboratories**

[NMRC](#)  
[NHRC](#)  
[NSMRL](#)  
[NAMRU-D](#)  
[NAMRU-SA](#)  
[NMRC-Asia](#)  
[NAMRU-3](#)  
[NAMRU-6](#)

**Collaboration**

[Working With Us](#)  
[Partnerships](#)  
[Research Services](#)  
[Naval Research](#)  
[Business Contacts](#)

**News**

[News & Media](#)  
[News Releases](#)  
[Fact Sheets](#)  
[Newsletters](#)  
[Media Inquiries](#)

**Research**

[Research Areas](#)

**Resources**

[BUMED](#)  
[Gorgas Library](#)  
[MED IG Hotline](#)  
[MHS](#)  
[NSC](#)  
[ONR](#)  
[USUHS](#)  
[WRAIR](#)  
[WRNMMC](#)  
[USMC](#)  
[USN](#)

